



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE/NOAA FISHERIES
Pacific Islands Fisheries Science Center
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96818

PROJECT REPORT¹

VESSEL: NOAA Ship *Oscar Elton Sette*, Project SE-15-01

PROJECT PERIOD: April 3 – 14, 2015

AREA OF OPERATION: Operations were conducted in the waters of the North Pacific along the 159°W meridian from 26.5°N to 32.5°N (Fig. 1).

TYPE OF OPERATION: Stepped oblique mid-water Cobb trawls of the shallow, nighttime sound scattering layer were conducted at stations spanning the North Pacific subtropical frontal zone (STFZ). Conductivity-temperature-depth (CTD) casts to 1000 m depth were conducted every 0.25° latitude across the STFZ. Two-hour acoustic transects were conducted every 0.5° latitude across the STFZ, as well as during both daytime and nighttime at trawling stations. Acoustic backscatter, and surface temperature and salinity were collected continuously throughout the project.

ITINERARY:

3 April 1900 Start of project. Embarked Phoebe Woodworth-Jefcoats, Donald Kobayashi, Melanie Abecassis, Adrienne Copeland, Jamison Gove, Eric Mooney, Jessica Chen, Aimee Hoover, Laura Lilly, Zack Oyafuso, Jesse Abdul, Lucas Moxey, Justin Miyano, Erin Kawamoto, and Kristen Gloeckler. Proceeded to first operation at 32.5°N, 159°W.

3 – 6 April Transit

6 April 2100 Arrived at 32.5°N, 159°W, began science operations. 2129 Began trawl tow 1. All trawl tows were stepped oblique tows, with 15 minutes of equilibration followed by 15 minutes of towing at each of four depths spanning the shallow scattering layer, as determined from EK60 data. 2344 Trawl tow 1 complete.

7 April 0120 Began trawl tow 2. 0342 Trawl tow 2 complete. 0419 Began acoustic transect 1. 0610 Acoustic transect 1 complete. 0642 Began CTD cast 1. Bottles 6 – 10 failed to fire, and once the CTD was on deck it was apparent that most of bottles 1 – 5 were leaky. To address the bottle firing issue, a connecting cable was replaced. Bottle closure mechanisms in the leaking bottles were replaced and/or bottles were switched out. 0832 Began acoustic transect 2. 1038 Acoustic

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transect 2 complete. 1052 Began CTD cast 1b, still unable to fire bottles. Deck unit switched. 1253 Began CTD cast 1c, a test cast to 100 m to see whether deck unit swap addressed the bottle firing failure. Test cast was successful and first successful CTD was conducted at 1318. 1424 CTD complete, transit to next station.

1620 Arrived at 32.25°N, 159°W, began CTD cast 2. 1708 CTD cast 2 complete, transit to next station.

1905 Arrived at 32°N, 159°W, began CTD cast 3. 2015 CTD cast 3 complete. 2041 Began acoustic transect 3. 2250 Acoustic transect 3 complete, transit to next station.

8 April 0137 Arrived at 31.75°N, 159°W, began CTD cast 4. 0226 CTD cast 4 complete, transit to next station.

0425 Arrived at 31.5°N, 159°W, began CTD cast 5. 0523 CTD cast 5 complete. 0640 Began acoustic transect 4 while transiting to next station. 0849 Acoustic transect 4 complete, continue transit.

0922 Arrived at 31.25°N, 159°W, began CTD cast 6. 1021 CTD cast 6 complete, transit to next station.

1211 Arrived at 31°N, 159°W, began CTD cast 7. 1320 CTD cast 7 complete. 1332 Began acoustic transect 5. 1536 Acoustic transect 5 complete, transit to next station.

1647 Arrived at 30.75°N, 159°W, began CTD cast 8. 1738 CTD cast 8 complete, transit to next station.

1925 Arrived at 30.5°N, 159°W, location of the transition zone chlorophyll front (TZCF) as indicated by MODIS satellite remotely-sensed data. Began CTD cast 9. 2031 CTD cast 9 complete. 2127 Began trawl tow 3 (TZCF tow 1). 2345 Trawl tow 3 complete.

9 April 0116 Began trawl tow 4 (TZCF replicate tow). 0328 Trawl tow 4 complete. 0357 Began acoustic transect 6. 0556 Acoustic transect 6 complete. 0754 Began acoustic transect 7. 1006 Acoustic transect 7 complete, drifter deployed, transit to next station.

1153 Arrived at 30.25°N, 159°W, began CTD cast 10. 1244 CTD cast 10 complete, transit to next station.

1446 Arrived at 30°N, 159°W, began CTD cast 11. 1543 CTD cast 11 complete. 1553 Began acoustic transect 8. 1800 Acoustic transect 8 complete, transit to next station.

1848 Arrived at 29.75°N, 159°W, began CTD cast 12. 1930 CTD cast 12 complete, attempted squid jigging. Due to high winds, jigging attempt abandoned after roughly 30 minutes, transit to next station.

2253 Arrived at 29.5°N, 159°W, began CTD cast 13.

10 April 0004 CTD cast 13 complete. 0007 Began acoustic transect 9. 0222 Acoustic transect 9 complete, attempted squid jigging. 0259 Squid jigging attempt abandoned due to high winds and rain, transit to next station.

0451 Arrived at 29.25°N, 159°W, began CTD cast 14. 0540 CTD cast 14 complete, transit to next station. Based on CTD-measured mixed layer temperature, station identified as possible location of the subtropical front (STF).

0739 Arrived at 29°N, 159°W, began CTD cast 15. 0847 CTD cast 15 complete. Based on CTD-measured mixed layer temperature, station identified as being south of the STF. 0901 Began acoustic transect 10. 1105 Acoustic transect 10 complete, transit back to previous station to fully sample the STF.

1334 Arrived at 29.25°N, 159°W, began CTD cast 16. 1440 CTD cast 16 complete. 1448 Began acoustic transect 11. 1832 Acoustic transect 11 complete. 2123 Begin trawl tow 5 (STF tow 1). 2338 Trawl tow 5 complete.

11 April 0115 Began trawl tow 6 (STF replicate tow). 0332 Trawl tow 6 complete. 0402 Began acoustic transect 12. 0602 Acoustic transect 12 complete, transit to next station.

0912 Arrived at 28.75°N, 159°W, began CTD cast 17. 1003 CTD cast 17 complete, transit to next station.

1203 Arrived at 28.5°N, 159°W, began CTD cast 18. 1306 CTD cast 18 complete. 1318 Began acoustic transect 13. 1523 Acoustic transect 13 complete, transit to next station.

1730 Arrived at 28.25°N, 159°W, began CTD cast 19. 1816 CTD cast 19 complete, transit to next station.

2005 Arrived at 28°N, 159°W, began CTD cast 20. Cast aborted due to communication failure with instrument package. 2110 Acoustic transect 14 conducted while troubleshooting CTD. CTD troubleshooting indicated that CTD wire needed to be reterminated. 2315 Acoustic transect 14 complete.

12 April 0038 Acoustic transect 15 conducted while CTD retermination was performed. 0238 Acoustic transect 15 complete. 0416 CTD cast 20 reattempted. 0515 CTD cast 20 successfully completed, transit to next station.

0702 Arrived at 27.75°N, 159°W, began CTD cast 21. 0757 CTD cast 21 complete, transit to next station.

0949 Arrived at 27.5°N, 159°W, began CTD cast 22. 1101 CTD cast 22 complete, transit to next station.

1247 Arrived at 27.25°N, 159°W, began CTD cast 23. 1334 CTD cast 23 complete, transit to next station.

1758 Arrived at 26.5°N, 159°W, began acoustic transect 16. 1855 Acoustic transect 16 complete. 1911 Began CTD cast 24. 2017 CTD cast 24 complete. 2123 Began trawl tow 7 (North Pacific subtropical gyre (NPSG) tow 1). 2215 Stepped oblique tow aborted due to discovery of significant hydraulic fluid leak associated with trawl winch. Net remained at depth 2 for approximately 1 hour while the leak was addressed. 2332 Leak repaired and net hauled to surface.

13 April 0118 Began trawl tow 8 (NPSG replicate tow). 0339 Trawl tow 8 complete. 0403 Began acoustic transect 17. 0605 Acoustic transect 17 complete, end science operations, begin transit to Pearl Harbor.

1243 Began test trawl with 1600 m wire paid out (test conducted per ship's request). 1448 Successful test tow complete, recommence transit to Pearl Harbor.

14 April 2000 Arrived at Pearl Harbor. End of project. Disembark Phoebe Woodworth-Jefcoats, Donald Kobayashi, Melanie Abecassis, Adrienne Copeland, Jamison Gove, Eric Mooney, Jessica Chen, Aimee Hoover, Laura Lilly, Zack Oyafuso, Jesse Abdul, Lucas Moxey, Justin Miyano, Erin Kawamoto, and Kristen Gloeckler.

MISSIONS AND RESULTS:

- A. Describe the physical environment of the North Pacific tuna and swordfish fishing grounds through routine conductivity-temperature-depth (CTD) casts and continuous acoustic Doppler current profiler (ADCP) and thermosalinograph (TSG) measurements.

A total of 24 fully successful CTD casts were conducted, all to a depth of 1000 m. During all casts, profiles of temperature, conductivity, and dissolved oxygen were collected on redundant sensors, and profiles of fluorescence were collected by both an open WET Labs and pumped Seapoint fluorometer (Fig. 2). CTD-measured mixed layer temperatures showed that the STF was located at roughly 29.25°N, within 0.5° latitude of the MODIS-indicated location (28.75°N).

The ADCP signal interfered with EK60 data collection and was secured for the entire survey. Interference between the ADCP and EK60 has not been a problem during previous STF surveys and it is recommended that investigation into this problem continue.

until a solution is reached that allows simultaneous operation of both instruments without degradation of data quality.

TSG data were collected at a roughly 5-sec resolution throughout the survey. A comparison with CTD data shows that problems with pump housing heating that arose during the previous STF survey have been corrected. On average, CTD surface temperatures (upper 5 m) and TSG temperatures were within 0.02 °C.

- B. Assess the influence of physical dynamics on the density, distribution, and composition of micronekton in the region by monitoring the biological backscatter using the Simrad EK60 echosounder system. Characterize the micronekton faunal composition and densities as the forage base for larger pelagic nekton.

A total of 17 acoustic transects were conducted to collect bioacoustic data on micronekton during this survey (Fig. 3). Data will be analyzed post-cruise.

- C. Assess the influence of the physical dynamics on the biological productivity in the region through CTD-mounted fluorometer measurements and extracted chlorophyll and accessory pigment determinations.

Two CTD-mounted fluorometers measured chlorophyll profiles to a depth of 1000 m during all 24 CTD casts: a pumped Seapoint fluorometer and an open WET Labs fluorometer. Water samples were collected at 10 depths during 13 of the CTDs for analysis of total chlorophyll, chlorophyll-*a*, nutrient, and HPLC analysis (Table 2; Fig. 4). Additionally, surface water samples were collected during all 24 CTD casts for analysis of total chlorophyll, chlorophyll-*a*, and low-threshold nitrate + nitrite (approximately 1 nM detection limit) analysis.

All chlorophyll analyses were carried out on a Turner 10AU bench-top fluorometer while underway. These analyses show that the TZCF was located at approximately 31°N, within 0.5° latitude of the MODIS-indicated location (30.5°N). Water samples for nutrient analysis and filtered content for HPLC were stored in the ship's scientific freezer for post-cruise analysis.

In addition to the samples discussed above, a second set of filtrate for chlorophyll-*a* analysis was retained for one station. This set was frozen in cuvettes for analysis post-cruise. Results will be compared with those from at-sea analysis to assess feasibility of doing all fluorometry analyses post-cruise on future projects.

- D. Conduct stern Cobb trawl operations targeting the depths of high sonic scattering layers to better our understanding of echosounder signals collected by the EK60 echosounder and of the micronekton faunal community composition.

Eight nighttime mid-water Cobb trawls were conducted, with duplicate tows at each of four stations (Figs. 1 and 5). All tows targeted the shallow scattering layer (approximately 25 – 140 m depth) and were stepped oblique tows with four depths. Due

to the lack of real-time net depth monitoring, the net was allowed to equilibrate for 15 minutes at each depth, and then was towed for 15 minutes at each depth. All trawls were approximately equal in duration, but further standardization of the catch data will be explored. A preliminary Cobb midwater trawl analysis is presented in Figure 5.

Two tows (tow 5 and 8) were compromised by cookie-cutter shark bites to the net's cod end. One tow (tow 7) was compromised by a hydraulic fluid leak during the tow that resulted in extended net time at depth two. A total of 10 tows were planned, but due to the reduced sea days allocated to this project, two tows had to be removed. These were the tows between the transition zone chlorophyll and subtropical fronts.

E. Conduct EK60 calibration should time and conditions allow.

Due to the reduced sea days allocated to this project, the EK60 calibration was not attempted.

F. Additional accomplishments

1. ITS chose SE-15-01 as a test case to scope out possible improvements in at-sea data collection, access, and storage. A schematic of the proposed draft implementation plan is shown in Fig. 6. This plan will be refined based on discussions with both ITS and EOD personnel. In brief, the EOD Cruise Data Management Improvement Plan is an ambitious project that will modernize the ship-based data collection process during the various research cruises conducted by the Science Center. To demonstrate project progress and conduct feasibility testing during the development process the overall plan has been split into phases. The phased approach has been designed to be flexible based on Science Center priorities. Each main phase contains multiple sub-phases (e.g., Phase 1F) with minimal dependencies between them. One main diagram (Fig. 6) has been developed to show the different aspects of the improvement plan and label each sub-phase of the project to help evaluate the optimal implementation plan based on Science Center priorities and available resources. This plan is split into two distinct main phases. Phase 1 will implement improvements to existing data management activities for EOD. Phase 1 improvements are limited in scope to the field data collection process while out at sea as well as pre- and post-cruise data management activities. Phase 2 will implement improvements to the overall data management process and satisfy a portion of the PARR requirements.
2. A prototype surface drifter was deployed at the TZCF (Fig. 7). This drifter will measure surface current, temperature, and salinity for the duration of its lifespan at liberty. Data are transmitted to shore at regular intervals via Iridium. In its initial time at sea, the drifter has been moving at roughly 0.5 m s^{-1} .

SCIENTIFIC PERSONNEL:

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FIGURES

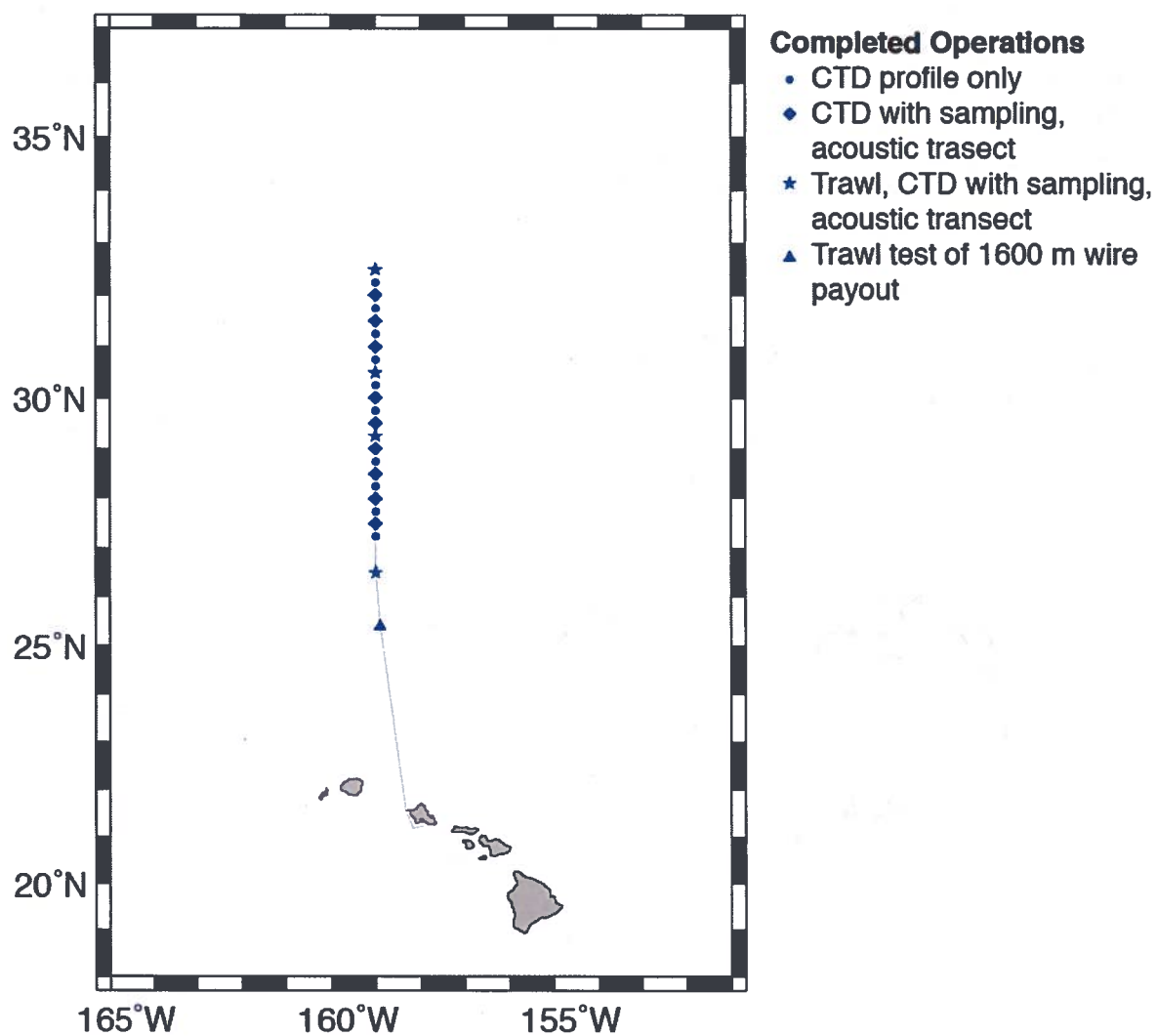


Fig. 1: Map of operations completed on SE-15-01.

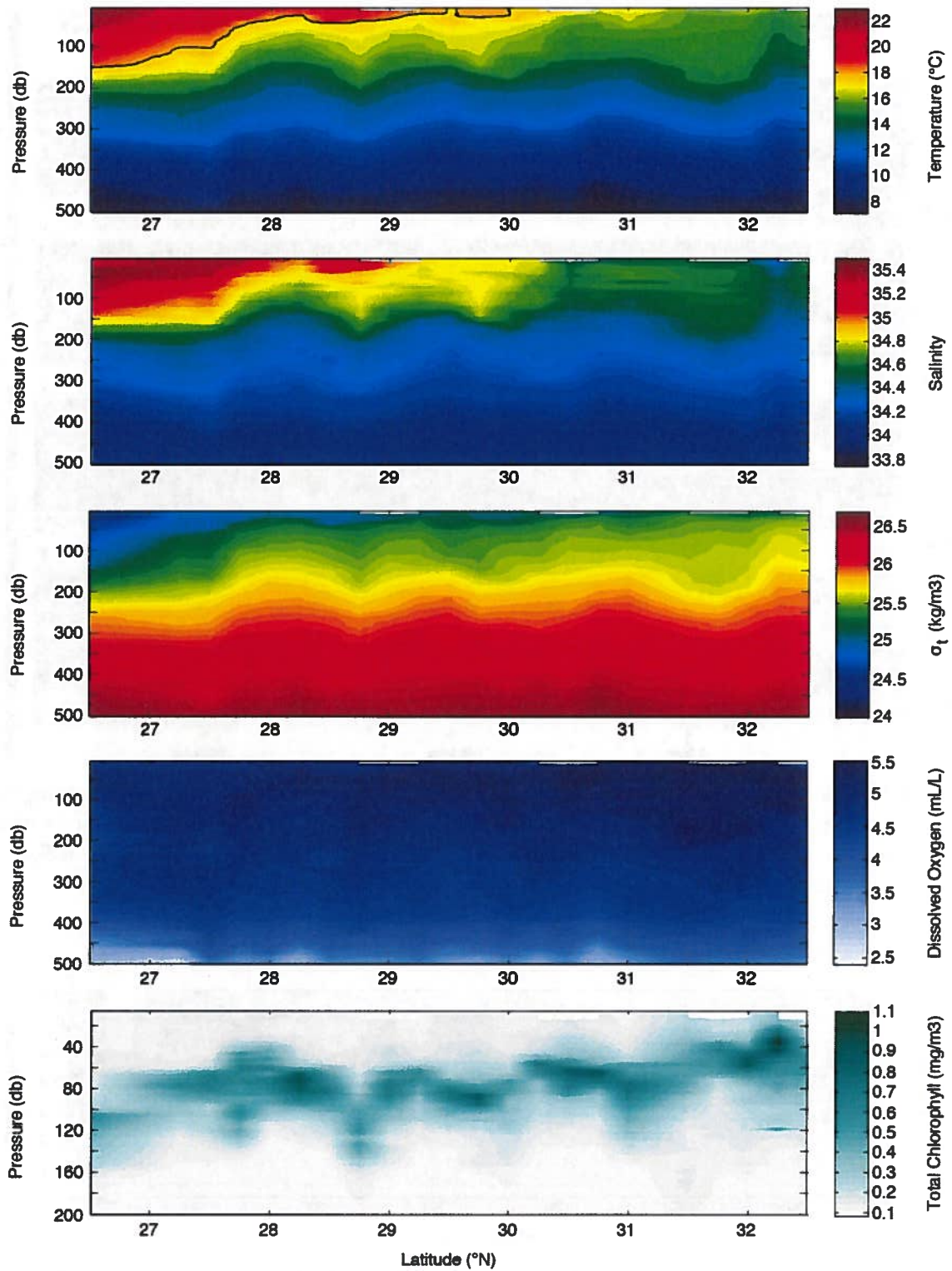


Fig. 2: Transects of temperature, salinity, density, dissolved oxygen, and total chlorophyll from the Seapoint fluorometer. The 18°C contour marking the surface subtropical front is shown in the temperature transect.

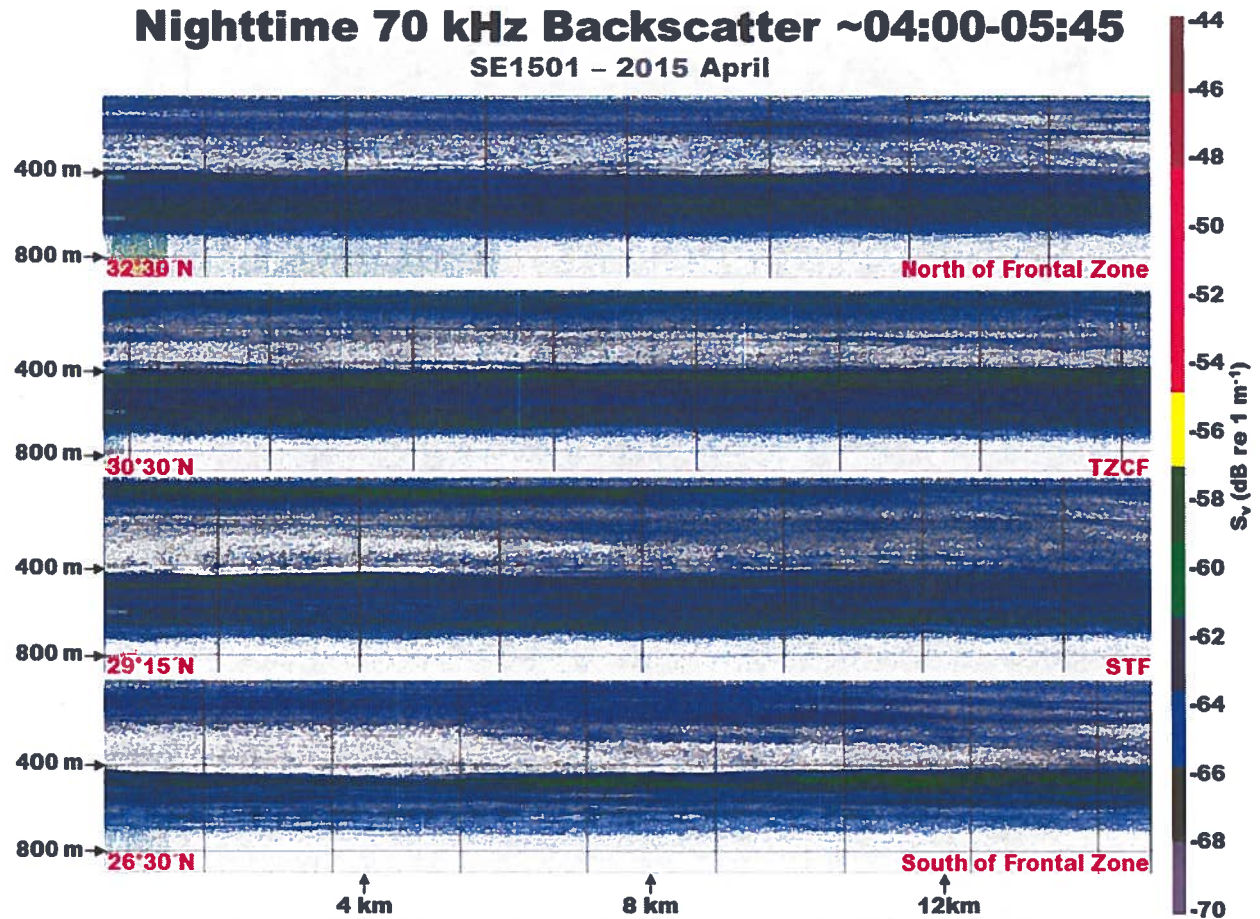


Fig. 3: Preliminary composite of EK60-measured acoustic backscatter at 70 kHz, showing both the deep and shallow scattering layers across the subtropical frontal zone at the locations where trawling was conducted. Trawl tows targeted the shallow scattering layer. Figure by Réka Domokos-Boyer.

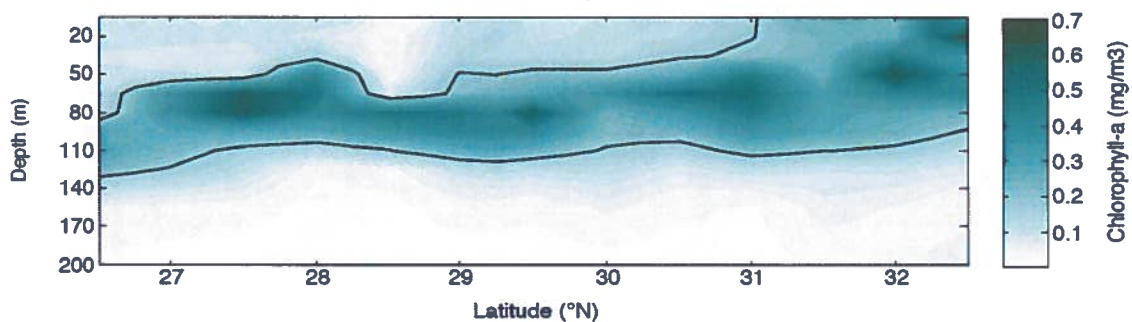


Fig. 4: Chlorophyll-*a* concentration as measured from CTD bottle samples. Note that bottle samples were collected at a coarser resolution than CTDs were conducted and at irregularly spaced depths (see Table 2). Data have been interpolated into 15-m depth bins and to match the horizontal resolution of Fig. 2. The 0.2 mg m^{-3} contour marking the surface transition zone chlorophyll front is shown.

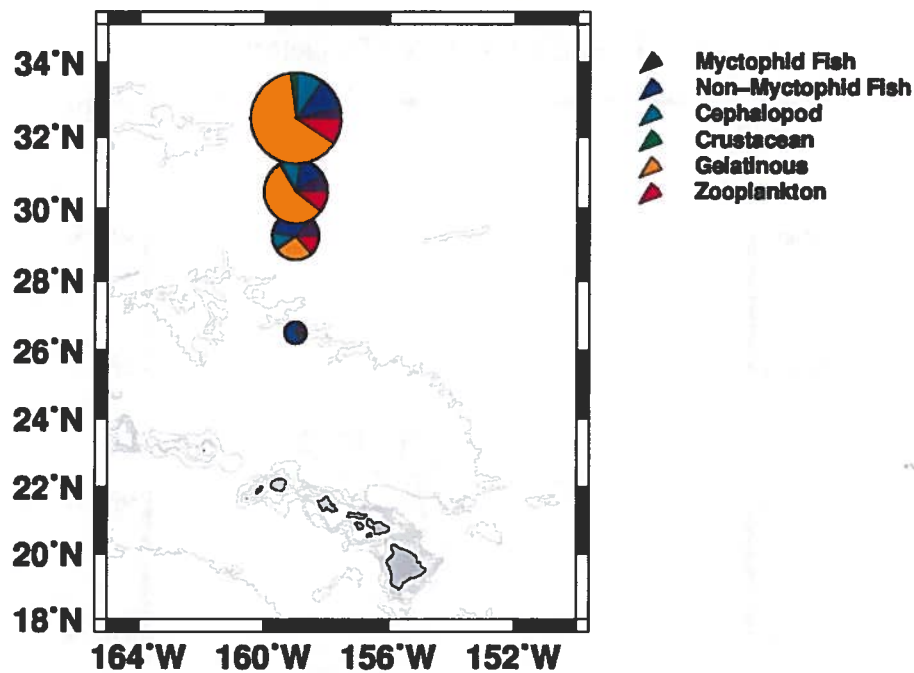


Fig. 5: Preliminary Cobb midwater trawl analysis showing the catch composition at 4 latitudinal stations as partitioned by wet weight of 6 taxonomic groupings: myctophid fish, non-myctophid fish, cephalopod, crustacean, gelatinous, and other zooplankton. The diameter of the circle is linearly proportional to the total biomass of the trawl catch. The data were averaged across replicates where available. Centroids of pie charts are placed at the longitude and latitude where trawling operations took place. Figure by Don Kobayashi.

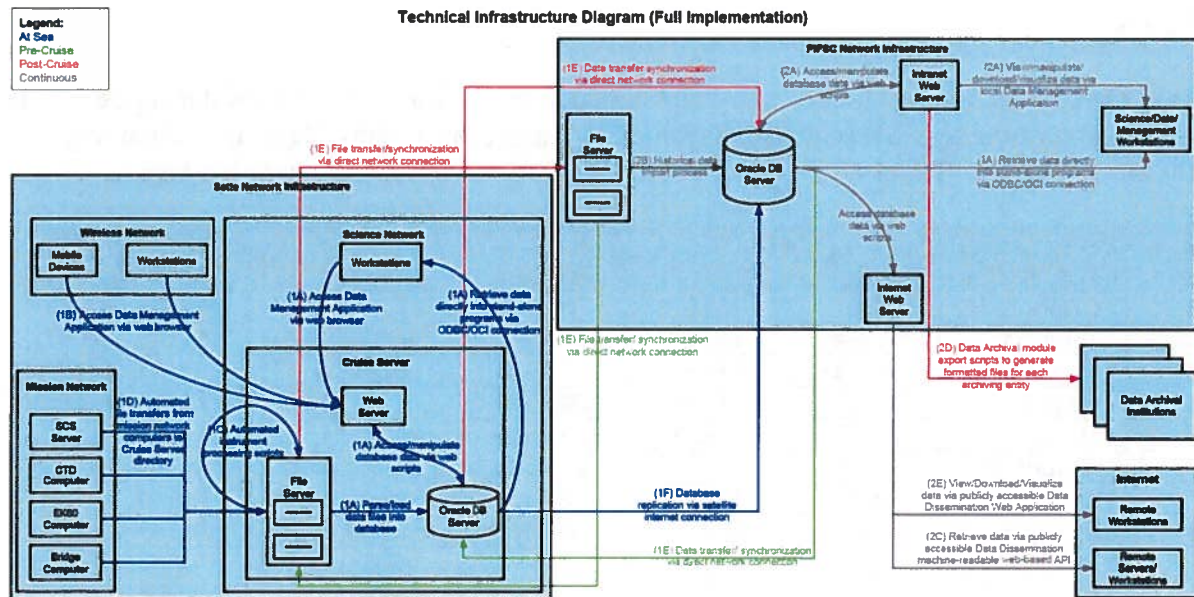


Fig. 6: Diagram of the preliminary EOD Cruise Data Management Improvement Plan. Figure by Jesse Abdul.

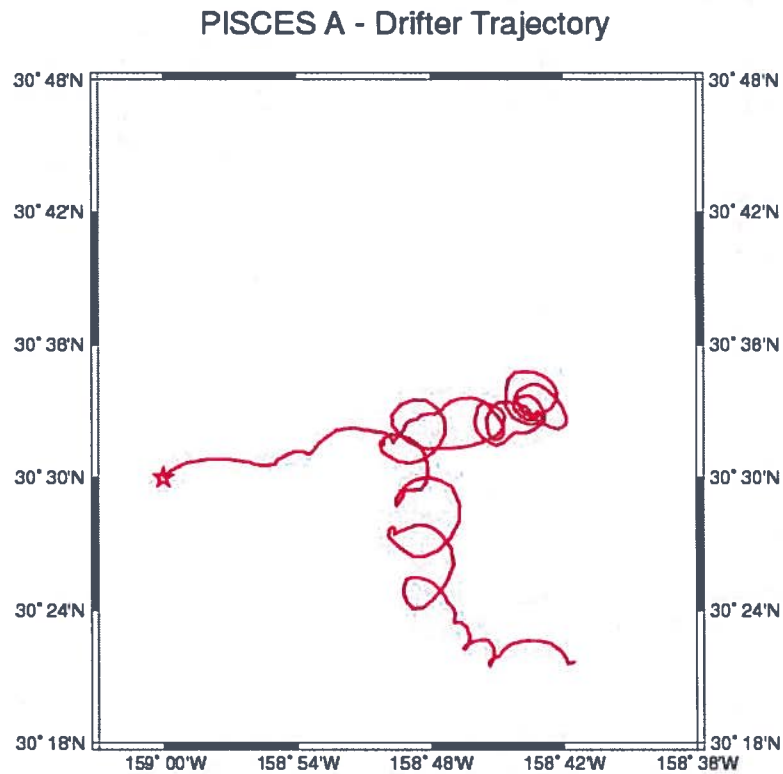


Fig. 7: Plot of the PICES A drifter trajectory for its first 15 days at liberty (9 – 23 April). The star denotes the deployment location at the transition zone chlorophyll front. Figure by Lucas Moxey.

TABLES

Table 1: Date, time, and location of two-hour stepped oblique trawls conducted during SE-15-01. Vertical extent of the shallow scattering layer (SSL), target tow depths (TD), and actual tow depths are also listed. Times and locations listed are those at which the operation began.

Trawl Tow	Date and Time (HST)	Lat. (°N)	Lon. (°W)	SSL Depth (m)	TD (m)	Depth (m)
1	6 April 2129	32.55	159.03	35 – 130	118, 94, 71, 47	117, 96, 74, -- ¹
2	7 April 0120	32.54	159.00	35 – 200	179, 138, 97, 56	190, 140, 100, 57
3	8 April 2127	30.53	158.98	20 – 120	108, 83, 58, 33	110, 87, 58, 30
4	9 April 0116	30.55	158.98	20 – 110	99, 76, 54, 31	97, 74, 49, 29
5 ²	10 April 2123	29.27	158.98	20 – 110	99, 76, 54, 31	104, 74, 53, 38
6	11 April 0115	29.26	158.99	20 – 110	99, 76, 54, 31	107, 82, 55, 34
7	12 April 2123	26.51	158.99	20 – 150	134, 101, 69, 36	119, 91, --, -- ³
8 ²	13 April 0118	26.51	159.00	20 – 180	160, 120, 80, 40	141, 99, 63, 32
9 ⁴	13 April 1243	25.40	158.90	--	1600, 1400, 1200, 1000	565, 543, 459, 353

¹Temperature-Depth Recorders failed above depth 3.

²Tow compromised by cookie-cutter shark bite to cod end.

³Trawl tow 7 aborted due to hydraulic fluid leak during tow at second depth.

⁴Trawl tow 9 was a test of paying out 1600 m wire, per ship's request. Target depths are wire payouts, not depths.

Table 2: Date, time, and location of 1000 m CTD casts conducted during SE-15-01. The Samples Collected column lists the post-cast analyses for which water samples were collected (HPLC = high-performance liquid chromatography; Nuts = nutrients; Chl = chlorophyll; LTN = low-threshold nitrate + nitrite, collected at surface only). The operation began at the times and locations listed below.

Cast	Date and Time (HST)	Latitude (°N)	Longitude (°W)	Samples Collected
1a	7 April 0642	32.50	159.00	
1b	7 April 1052	32.50	159.00	
1c ¹	7 April 1253	32.50	159.00	
1	7 April 1318	32.50	159.00	HPLC, Nuts, Chl, LTN ²
2	7 April 1620	32.25	159.00	Surface only: Chl, LTN
3	7 April 1905	32.00	159.00	HPLC, Nuts, Chl, LTN
4	8 April 0137	31.75	159.00	Surface only: Chl, LTN
5	8 April 0425	31.50	159.00	HPLC, Nuts, Chl, LTN
6	8 April 0922	31.25	159.00	Surface only: Chl, LTN
7	8 April 1211	31.00	159.00	HPLC, Nuts, Chl, LTN
8	8 April 1647	30.75	159.00	Surface only: Chl, LTN
9	8 April 1925	30.50	158.99	HPLC, Nuts, Chl, LTN
10	9 April 1153	30.25	159.00	Surface only: Chl, LTN
11	9 April 1446	30.00	159.00	HPLC, Nuts, Chl, LTN
12	9 April 1848	29.75	159.00	Surface only: Chl, LTN
13	9 April 2253	29.50	159.00	HPLC, Nuts, Chl, LTN
14	10 April 0451	29.25	159.00	Surface only: Chl, LTN
15	10 April 0739	29.00	159.00	HPLC, Nuts, Chl, LTN
16	10 April 1334	29.25	159.00	HPLC, Nuts, Chl, LTN
17	11 April 0912	28.75	159.00	Surface only: Chl, LTN
18	11 April 1203	28.50	159.00	HPLC, Nuts, Chl, LTN
19	11 April 1730	28.25	159.00	Surface only: Chl, LTN
20a	11 April 2005	28.00	159.00	
20	12 April 0416	28.00	159.00	HPLC, Nuts, Chl, LTN
21	12 April 0702	27.75	159.00	Surface only: Chl, LTN
22	12 April 0949	27.50	159.00	HPLC, Nuts, Chl, LTN
23	12 April 1247	27.25	159.00	Surface only: Chl, LTN
24	12 April 1911	26.50	159.00	HPLC, Nuts, Chl, LTN

¹Cast to 100 m to test whether bottles would fire.

²Bottle samples for HPLC, Nuts, and Chl were collected at the following depths: 200, 150, 125, 100, 80, 65, 50, 35, and 20 m, and at the surface.

Table 3: Date, time, and location of 2-hour acoustic transects conducted during SE-15-01. Times listed are the time the acoustic transect started and locations are the targeted starting location.

Acoustic Transect	Date and Time (HST)	Latitude (°N)	Longitude (°W)
1	7 April 0419	32.50	159.00
2	7 April 0832	32.50	159.00
3	7 April 2041	32.00	159.00
4	8 April 0640	31.25*	159.00
5	8 April 1332	31.00	159.00
6	9 April 0357	30.50	159.00
7	9 April 0754	30.50	159.00
8	9 April 1553	30.00	159.00
9	10 April 0007	29.50	159.00
10	10 April 0901	29.00	159.00
11	10 April 1448	29.25	159.00
12	11 April 0402	29.25	159.00
13	11 April 0318	28.50	159.00
14	11 April 2110	28.00	159.00
15	12 April 0038	28.00	159.00
16	12 April 1758	26.50	159.00
17	13 April 0403	26.50	159.00

* Acoustic transect planned for 31.50°N, 159.00°W conducted en route to 31.25°N, 159.00°W due to miscommunication between science party and bridge.